discussed differences, which are disclosed in detail in the patent specification, do not define the scope or interpretation of any of the claims. Where presented below, such discussed differences merely help the Examiner appreciate important claim distinctions discussed thereafter.

Generally, the disclosed embodiments are directed to methods and apparatus having trench isolation structures with reduced isolation pad heights and reduced edge spacers. In one embodiment, an microelectronic device comprises a microelectronic substrate having a surface, a gate structure including a gate oxide layer formed on the surface of the substrate, a first gate layer formed on the gate oxide layer, and an adhesion layer formed on the first gate layer. The gate structure has a trench at least partially disposed therein and extending into the substrate substantially perpendicularly to the surface of the substrate, and a field oxide layer is at least partially in the trench. The field oxide layer has sides that are substantially straight and substantially parallel from a bottom of the trench to a top surface of the field oxide layer, the substantially straight sides not contacting the gate oxide layer and extending upwardly from the trench and not extending laterally from the trench over an upper surface of the substrate, the field oxide layer having a field oxide level between the level of the upper surface of the substrate and the level of an upper surface of the first gate layer.

In an alternate embodiment, Applicants teach a microelectronic device comprising a microelectronic substrate having a trench formed in a surface thereof, the trench extending into the substrate substantially perpendicularly to the surface of the substrate, and a field oxide in the trench. The field oxide has sides that are substantially straight and substantially parallel from a bottom of the trench to a top surface of the field oxide layer, the substantially straight sides projecting outwardly from the trench substantially perpendicularly to the surface of the substrate beyond the surface of the substrate and not extending laterally from the trench over the surface of the substrate. A component is formed on the field oxide, the component extending from the field oxide by a height at least equal to approximately two times a height that the field oxide extends from the trench beyond the surface of the substrate.

The microelectronic structures taught by Applicants provide several advantages over prior art structures. Because the height of the field oxide "isolation pad" is reduced compared with the height of the gate structure, edge spacers that may otherwise form along the

edges of the isolation pad are reduced or eliminated. Therefore, the isolation pad advantageously requires less surface area on the apparatus.

Furthermore, because the field oxide has sides that are substantially straight and substantially parallel from a bottom of the trench to a top surface of the field oxide layer, the substantially straight sides not extending laterally from the trench over the surface of the substrate, the field oxide isolation pad occupies less space on the substrate which is critical to the design of highly integrated microelectronics devices. Isolation pad structures that project outwardly from the trench may also provide improved isolation characteristics between adjacent components formed on the substrate and components formed on the isolation pad.

<u>Shimbo</u>

Shimbo (U.S. 4,980,306) teaches a semiconductor device having an isolation trench 30 formed within a p-type substrate 1 between a pair of adjacent transistors 100, 200. A p-type selective epitaxial film 20 is formed on the sidewalls and bottom of the trench 30. A silicon dioxide 17 is formed within the trench 30 on the p-type epitaxial film 20. As shown in Figure 2c of Shimbo, the silicon dioxide 17 projects laterally from the trench 30 over surrounding portions of the p-type film 20, and the sides of the silicon dioxide 17 are not substantially straight and substantially parallel from a bottom of the trench 30 to a top surface of the silicon dioxide 17. On the contrary, the cross-sectional shape of the silicon dioxide 17 forms a "T" shape. Also, as shown in Figure 2e, the silicon dioxide 17 projects upwardly from the trench 30 to a height that is greater than the first gate layers 104, 204 of the adjacent transistors 100, 200.

Shimbo does not disclose, teach or fairly suggest the microelectronics structures taught by Applicants. Specifically, Shimbo does not teach or suggest microelectronics structures including a field oxide layer *having sides that are substantially straight and substantially parallel from a bottom of the trench to a top surface of the field oxide layer*. As described above, the sides of the silicon dioxide 17 taught by Shimbo are discontinuous (not substantially straight from the bottom of the trench to the top of the silicon dioxide) and generally form a "T" cross-sectional shape.

Shimbo also does not disclose, teach or fairly suggest the microelectronics structures including a field oxide layer having a field oxide level between the level of the upper surface of the substrate and the level of an upper surface of the first gate layer. On the contrary, as shown in Figures 2f and 3a, Shimbo teaches that the field oxide level is *greater* than the level of the upper surface of the first gate layers 104, 204 of the adjacent transistors 100, 200. As a result, in the microelectronics structures taught by Applicants, there is less edge of the field oxide layer for edge spacers to form. Thus, Shimbo does not disclose, teach or fairly suggest microelectronics structures taught by Applicants.

Finally, Shimbo does not teach that the substantially straight sides *not extending laterally from the trench over the surface of the substrate*. In the Office Action dated August 15, 2001, the Examiner asserted that Figures 2f and 3a of Shimbo teach a field oxide having substantially straight sides and not extending laterally from the trench over the surface of the substrate. Applicants have carefully reviewed Shimbo in this regard, and respectfully note that Shimbo teaches otherwise. According to Shimbo, the source 112 is "formed in the substrate 1" (3:65-66). Shimbo further teaches that the drain 212 is "formed in the well 210" (3:67-68), the well 210 itself being "locally formed in ... substrate 1" (3:27-29). Thus, according to the teachings of Shimbo, the source 112 and drain 212 are "formed in the substrate" ... "by means of, for example, ion implantation[.]" (3:65-4:1). Applicants respectfully submit that the source and drain regions shown in Figures 2f and 3a are indeed part of the substrate according to the teachings of Shimbo, and that the silicon dioxide 17 of Shimbo extends laterally over these regions.

<u>Nakajima et al.</u>

Nakajima et al. (U.S. 5,329,482) teaches a semiconductor memory device. As best shown in Figure 5, Nakajima et al. teaches a memory device that includes a substrate 1 having a transistor 3 formed thereon. The transistor 3 includes a gate oxide film 5 formed on the substrate 1, and a gate electrode 6 formed on the gate oxide film 5. (5:20-22). A thick field oxide film 2 is formed in the substrate 1 using a localized oxidation of silicon (LOCOS) process. (5:13-15).

Nakajima et al. does not disclose, teach or fairly suggest the microelectronics structures taught by Applicants. Specifically, Nakajima et al. does not teach or suggest microelectronics structures including a field oxide layer *having sides that are substantially straight and substantially parallel from a bottom of the trench to a top surface of the field oxide layer*. According to the teachings of Nakajima et al., and as best shown in Figure 5 of Nakajima et al., the sides of the field oxide 2 are not substantially parallel from a bottom of the trench to a top surface of the field oxide. Rather, the field oxide 2 of Nakajima et al. generally forms a "V" cross-sectional shape that is wider at the top than at the bottom. Consequently, the field oxide 2 taught by Nakajima et al. may take up more surface area on the substrate than the field oxide taught by Applicants.

Furthermore, Nakajima et al. teaches that the thick field oxide film 2 is formed in the substrate 1 using a LOCOS process. Thus, there is no trench formed in the substrate that is filled with field oxide, as taught by Applicants. For this additional reason, Nakajima et al. does not teach or suggest the structures taught by Applicants.

Park et al.

Park et al. (U.S. 5,296,400) teaches methods of manufacturing semiconductor devices. According to Park et al., a semiconductor device includes a substrate 1, and a transistor having a gate oxide layer 4 formed on the substrate 1 and a gate electrode 5 formed on the gate oxide layer 4 (see Figure 1A). Park et al. further teaches a field oxide layer 3 formed in the substrate 1 by a conventional LOCOS method.

Park et al. does not teach or suggest the microelectronics structures taught by Applicants. Specifically, Park et al. does not teach or suggest microelectronics structures including a field oxide layer *having sides that are substantially straight and substantially parallel from a bottom of the trench to a top surface of the field oxide layer*. According to the teachings of Park et al., the sides of the field oxide layer 3 are not substantially parallel from a bottom of the trench to a top surface of the field oxide. Rather, the field oxide 3 of Park et al. exhibits the generally rounded or "bird's beak" shape typical of conventional LOCOS processes.

Furthermore, because Park et al. teaches that the field oxide layer 3 is formed using a LOCOS process, there is no trench formed in the substrate that is filled with field oxide, as taught by Applicants. For this additional reason, Park et al. does not teach or suggest the structures taught by Applicants.

Noguchi et al.

Noguchi et al. (U.S. 4,935,802) teaches methods of manufacturing semiconductor devices. According to Noguchi et al., a semiconductor device includes a substrate 5, and a transistor 20 having a gate layer 2 formed on the substrate 5 and a gate electrode 3 formed on the gate layer 2 (see Figure 2). Noguchi et al. further teaches a field insulating layer 4 formed in the substrate 5 by a conventional LOCOS method.

As with the preceding references, Noguchi et al. does not teach or suggest the microelectronics structures taught by Applicants. Specifically, Noguchi et al. does not teach or suggest microelectronics structures including a field oxide layer *having sides that are substantially straight and substantially parallel from a bottom of the trench to a top surface of the field oxide layer*. According to Noguchi et al., the sides of the field insulating layer 4 are not substantially parallel from a bottom of the trench to a top surface of the field oxide. Rather, the field insulating layer 4 of Noguchi et al. exhibits the generally rounded or "bird's beak" shape typical of conventional LOCOS processes.

Furthermore, because Noguchi et al. teaches that the field insulating layer 4 is formed using a LOCOS process, there is no trench formed in the substrate that is filled with field oxide, as taught by Applicants. For this additional reason, Noguchi et al. does not teach or suggest the structures taught by Applicants.

Manning

Manning (U.S. 5,177,028) teaches microelectronic devices including a trench 108 formed in a substrate 102. As best shown in Manning's Figure 13, a field oxide layer 112 is formed within the trench 108 and a pad oxide layer 104 is formed on the substrate 102 in contact

with the field oxide layer 112. Thus, Manning teaches an isolation structure that extends upwardly from the trench 108 (field oxide layer 112) and that also extends laterally over the surface of the substrate 102 (pad oxide layer 104).

Manning does not disclose, teach or fairly suggest the microelectronics structures as taught by Applicants. Specifically, Manning does not teach or suggest microelectronics structures including a field oxide layer *having substantially straight sides* and *extending upwardly from the trench and not extending laterally from the trench over an upper surface of the substrate.* As described above, according to Manning, the field oxide extends laterally over the surface of the substrate.

There is also no motivation to combine the teachings of Manning with the teachings of Park et al. or Noguchi et al.. Both Park et al. and Noguchi et al. teach forming a oxide using a LOCOS process. Therefore, as described above, the field oxides of Park et al. and Noguchi et al. exhibit the generally rounded or "bird's beak" shape typical of conventional LOCOS processes, and do require a trench formed in the substrate. Conversely, Manning teaches away from Park et al. and Noguchi et al. by teaching a field oxide formed using a trench isolation method. Therefore, Applicants respectfully submit that the teachings of Park et al. and Noguchi et al. may not be properly combined with the teachings of Manning.

Assuming that the teachings of Manning and those of Park et al. and Noguchi et al. may be combined, the resulting combination of teachings still fails to teach or suggest the structures taught by Applicants. The resulting combination of teachings does not disclose a structure *having substantially straight sides ... not extending laterally from the trench over an upper surface of the substrate.*

I. Rejection of claim 34 under 35 USC § 102(b) as being anticipated by Shimbo (US 4,980,306).

Turning now to the specific language of the claims, claim 34 recites a microelectronic device, comprising a microelectronic substrate having a surface with a trench formed therein; a field oxide within the trench and *having sides that are substantially straight and substantially parallel from a bottom of the trench to a top surface of the field oxide, the*

substantially straight sides projecting therefrom substantially perpendicularly to the surface of the substrate by a height which is small enough to prevent the formation of spacers adjacent the field oxide, the field oxide not extending laterally from the trench over the surface of the substrate; and a component formed on the field oxide. (emphasis added).

As described more fully above, Shimbo does not disclose, teach or fairly suggest the microelectronics device recited in claim 34. Specifically, Shimbo does not teach or suggest a microelectronics device including a field oxide layer *having sides that are substantially straight and substantially parallel from a bottom of the trench to a top surface of the field oxide layer*. As described above, the sides of the silicon dioxide 17 taught by Shimbo are discontinuous (not substantially straight from the bottom of the trench to the top of the silicon dioxide) and generally form a "T" cross-sectional shape. Also, Shimbo does not teach that the substantially straight sides *not extending laterally from the trench over the surface of the substrate*. According to Shimbo, the silicon dioxide 17 of Shimbo extends laterally over the source and drain regions of the substrate.

For the foregoing reasons, Applicants respectfully request reconsideration and withdrawal of the rejection of claims 34 under 35 USC § 102(b) as being anticipated by Shimbo.

II. Rejection of claims 22, and 28-29 under 35 USC § 102(b) as being anticipated by Nakajima et al. (US 5,329,482).

Claim 22

Claim 22 recites a microelectronic device comprising a microelectronic substrate having an upper surface; a gate structure including a gate oxide layer formed on the upper surface of the substrate, a first gate layer formed on the gate oxide layer, and an adhesion layer formed on the first gate layer, *the gate structure having a trench at least partially disposed therein and extending into the substrate substantially perpendicularly to the upper surface* of the substrate; and a field oxide layer at least partially in the trench, *the field oxide layer having sides that are substantially straight and substantially parallel from a bottom of the trench to a top surface of the field oxide layer*, the substantially straight sides not contacting the gate oxide layer and *extending upwardly from the trench substantially perpendicularly to the upper surface of the*

substrate and not extending laterally from the trench over the upper surface of the substrate, the field oxide layer having a field oxide level between the level of the upper surface of the substrate and the level of an upper surface of the first gate layer. (emphasis added).

As described more fully above, Nakajima et al. does not disclose, teach or fairly suggest the microelectronics device recited in claim 22. Specifically, Nakajima et al. does not teach or suggest a microelectronics device including a field oxide layer *having sides that are substantially straight and substantially parallel from a bottom of the trench to a top surface of the field oxide layer*. According to the teachings of Nakajima et al., the sides of the field oxide 2 are not substantially parallel from a bottom of the trench to a top surface of the field oxide (Figure 5). Furthermore, because Nakajima et al. teaches that the thick field oxide film 2 is formed using a LOCOS process, there is no trench formed in the substrate as recited in claim 22.

<u>Claims 28-29</u>

Similarly, claim 28 recites a microelectronic device comprising a microelectronic *substrate having a trench formed in a surface thereof, the trench extending into the substrate substantially perpendicularly to the surface of the substrate*; a field oxide in the trench, *the field oxide having sides that are substantially straight and substantially parallel from a bottom of the trench to a top surface of the field oxide, the substantially straight sides extending from the trench beyond the surface of the substrate substantially perpendicularly to the surface of the substrate and not extending laterally from the trench over the surface of the substrate*; and a gate structure formed on the substrate, the gate structure extending from the field oxide by a height at least equal to approximately two times a height that the field oxide extends from the trench beyond the surface of the substrate, the field oxide not contacting any portion of the gate structure. (emphasis added).

Again, Nakajima et al. does not disclose, teach or fairly suggest the microelectronics device recited in claim 28. Specifically, Nakajima et al. does not teach or suggest a microelectronics device including a field oxide layer *having sides that are substantially straight and substantially parallel from a bottom of the trench to a top surface of the field oxide layer*. According to the teachings of Nakajima et al., the sides of the field oxide 2 are not

substantially parallel from a bottom of the trench to a top surface of the field oxide (Figure 5). Furthermore, because Nakajima et al. teaches that the thick field oxide film 2 is formed using a LOCOS process, there is no trench formed in the substrate as recited in claim 28. Claim 29 depends from claim 28 and is patentable over Nakajima et al. for the same reasons as claim 28.

For the foregoing reasons, Applicants respectfully request reconsideration and withdrawal of the rejection of claim 22 and 28-29 under 35 USC § 102(b) as being anticipated by Nakajima et al..

III. Rejection of claims 22 and 24-37 under 35 USC § 103(a) as being unpatentable over Park et al. (US 5,296,400) in view of Manning (U.S. 5,177,028), and the rejection of claims 22, 24-25, 28-29, and 32-37 under 35 USC § 103(a) as being unpatentable over Noguchi et al. (US 4,935,802) in view of Manning.

<u>Claim 22, 24-25, and 35-37</u>

Claim 22 recites a microelectronic device comprising a microelectronic substrate having an upper surface; a gate structure including a gate oxide layer formed on the upper surface of the substrate, a first gate layer formed on the gate oxide layer, and an adhesion layer formed on the first gate layer, *the gate structure having a trench at least partially disposed therein and extending into the substrate substantially perpendicularly to the upper surface* of the substrate; and a field oxide layer at least partially in the trench, *the field oxide layer having sides that are substantially straight and substantially parallel from a bottom of the trench to a top surface of the field oxide layer*, the substantially straight sides not contacting the gate oxide layer and *extending upwardly from the trench substantially perpendicularly to the upper surface of the substrate and not extending laterally from the trench over the upper surface of the substrate*, the field oxide layer having a field oxide level between the level of the upper surface of the substrate and the level of an upper surface of the first gate layer. (emphasis added).

As set forth above, neither Park et al., Noguchi et al., or Manning, singly or in combination, teaches or suggests the microelectronics device recited in claim 22. Specifically, Park et al. and Noguchi et al. do not teach or suggest a microelectronics device including a field oxide layer *having sides that are substantially straight and substantially parallel from a bottom*

of the trench to a top surface of the field oxide layer. According to the teachings of Park et al. and Noguchi et al., the field oxide has the generally rounded or "bird's beak" shape typical of conventional LOCOS processes. Furthermore, according to Park et al. and Noguchi et al., there is no trench formed in the substrate that is filled with field oxide, as taught by Applicants. Similarly, Manning does not teach or suggest the microelectronics device recited in claim 22 because, according to Manning, the field oxide extends laterally over the surface of the substrate.

As described more fully above, there is no motivation to combine the teachings of Manning with the teachings of Park et al. and/or Noguchi et al. because Manning teaches away from Park et al. and/or Noguchi et al. by teaching a field oxide formed using a trench isolation method, whereas Park et al. teaches using a LOCOS method. Therefore, the teachings of Park et al. and/or Noguchi et al. may not be properly combined with the teachings of Manning.

Even assuming that the teachings of Manning and Park et al. and/or Noguchi et al. may be combined, the resulting combination still fails to teach or suggest the device recited in claim 22. The resulting combination of teachings does not disclose a structure *having substantially straight sides ... not extending laterally from the trench over an upper surface of the substrate.*

Claims 24-25 and 35-37 depend from claim 22 and are patentable over the cited references for the same reasons as claim 22 and also due to additional limitations contained in those claims. For example, claim 24 recites the microelectronic device of claim 22, further comprising a silicide layer formed on the adhesion layer. Similarly, claim 25 recites the microelectronic device of claim 22, further comprising a conductive layer formed on the adhesion layer. Claim 36 recites the microelectronic device of claim 22 wherein the field oxide level is less than or equal to approximately one half the distance between the upper surface of the substrate and the upper surface of the first gate layer. Finally, claim 37 recites the microelectronic device of claim 24 wherein the field oxide level is less than or equal to approximately one half the distance between the upper surface of the substrate and the upper surface of the silicide layer. These additional limitations are also not taught or suggested by the teachings of Park et al., Noguchi et al., and Manning.

Claims 26-27

Similarly, claim 26 recites a microelectronic device comprising a microelectronic *substrate having a trench formed in a surface thereof, the trench extending into the substrate substantially perpendicularly to the surface of the substrate*; a field oxide in the trench, *the field oxide having sides that are substantially straight and substantially parallel from a bottom of the trench to a top surface of the field oxide, the substantially straight sides projecting outwardly from the trench beyond the surface of the substrate substantially perpendicularly to the surface of the substrate and not extending laterally from the trench over the surface of the substrate*; and a component formed on the field oxide, the component extending from the field oxide by a height at least equal to approximately two times a height that the field oxide extends from the trench beyond the surface of the substrate. (emphasis added).

As set forth above, neither Park et al., Noguchi et al., or Manning, singly or in combination, teaches or suggests the microelectronics device recited in claim 26. Specifically, Park et al. and Noguchi et al. do not teach or suggest a microelectronics device including a field oxide layer *having sides that are substantially straight and substantially parallel from a bottom of the trench to a top surface of the field oxide layer.* According to the teachings of Park et al. and Noguchi et al., the field oxide has the generally rounded or "bird's beak" shape typical of conventional LOCOS processes. Furthermore, according to Park et al. and Noguchi et al., there is no trench formed in the substrate that is filled with field oxide, as taught by Applicants. Similarly, Manning does not teach or suggest the microelectronics device recited in claim 26 because, according to Manning, the field oxide extends laterally over the surface of the substrate.

As described more fully above, there is no motivation to combine the teachings of Manning with the teachings of Park et al. and/or Noguchi et al. because Manning teaches away from Park et al. and/or Noguchi et al. by teaching a field oxide formed using a trench isolation method, whereas Park et al. teaches using a LOCOS method. Therefore, the teachings of Park et al. and/or Noguchi et al. may not be properly combined with the teachings of Manning.

Even assuming that the teachings of Manning and Park et al. and/or Noguchi et al. may be combined, the resulting combination still fails to teach or suggest the device recited in claim 26. The resulting combination of teachings does not disclose a structure *having*

substantially straight sides ... not extending laterally from the trench over an upper surface of the substrate.

Claim 27 depends from claim 26 and is patentable over the cited references for the same reasons as claim 26.

Claims 28-29

Similarly, claim 28 recites a microelectronic device comprising a microelectronic *substrate having a trench formed in a surface thereof, the trench extending into the substrate substantially perpendicularly to the surface of the substrate*; a field oxide in the trench, *the field oxide having sides that are substantially straight and substantially parallel from a bottom of the trench to a top surface of the field oxide, the substantially straight sides extending from the trench beyond the surface of the substrate substantially perpendicularly to the surface of the substrate and not extending laterally from the trench over the surface of the substrate*; and a gate structure formed on the substrate, the gate structure extending from the field oxide by a height at least equal to approximately two times a height that the field oxide extends from the trench beyond the surface of the substrate, the field oxide not contacting any portion of the gate structure. (emphasis added).

Again, neither Park et al., Noguchi et al., or Manning, singly or in combination, teaches or suggests the microelectronics device recited in claim 28. Specifically, Park et al. and Noguchi et al. do not teach or suggest a microelectronics device including a field oxide layer *having sides that are substantially straight and substantially parallel from a bottom of the trench to a top surface of the field oxide layer*. According to the teachings of Park et al. and Noguchi et al., the field oxide has the generally rounded or "bird's beak" shape typical of conventional LOCOS processes. Furthermore, according to Park et al. and Noguchi et al., there is no trench formed in the substrate that is filled with field oxide, as taught by Applicants. Similarly, Manning does not teach or suggest the microelectronics device recited in claim 28 because, according to Manning, the field oxide extends laterally over the surface of the substrate.

As described more fully above, there is no motivation to combine the teachings of Manning with the teachings of Park et al. and/or Noguchi et al. because Manning teaches away

from Park et al. and/or Noguchi et al. by teaching a field oxide formed using a trench isolation method, whereas Park et al. teaches using a LOCOS method. Therefore, the teachings of Park et al. and/or Noguchi et al. may not be properly combined with the teachings of Manning.

Even assuming that the teachings of Manning and Park et al. and/or Noguchi et al. may be combined, the resulting combination still fails to teach or suggest the device recited in claim 28. The resulting combination of teachings does not disclose a structure *having substantially straight sides ... not extending laterally from the trench over an upper surface of the substrate*.

Claim 29 depends from claim 28 and is patentable over the cited references for the same reasons as claim 28.

Claims 30-31

Similarly, claim 30 recites a microelectronic device comprising a microelectronic substrate having *a recess formed in a surface thereof, the recess extending into the substrate substantially perpendicularly to the surface of the substrate*; and *a field oxide deposited in the recess, the field oxide having sides that are substantially straight and substantially parallel from a bottom of the recess to a top surface of the field oxide, the substantially straight sides extending substantially perpendicularly to the surface of the substrate from the recess beyond the surface of the substrate* by a height which is less than or equal to approximately one half of a height of a component formed on the field oxide, *the field oxide not extending laterally from the recess over the surface of the substrate*. (emphasis added).

Again, as set forth above, neither Park et al., Noguchi et al., or Manning, singly or in combination, teaches or suggests the microelectronics device recited in claim 30. Specifically, Park et al. and Noguchi et al. do not teach or suggest a microelectronics device including a field oxide layer *having sides that are substantially straight and substantially parallel from a bottom of the recess to a top surface of the field oxide layer*. According to the teachings of Park et al. and Noguchi et al., the field oxide has the generally rounded or "bird's beak" shape typical of conventional LOCOS processes. Furthermore, according to Park et al. and Noguchi et al., there is no recess formed in the substrate that is filled with field oxide, as taught by Applicants.

Similarly, Manning does not teach or suggest the microelectronics device recited in claim 30 because, according to Manning, the field oxide extends laterally over the surface of the substrate.

As described more fully above, there is no motivation to combine the teachings of Manning with the teachings of Park et al. and/or Noguchi et al. because Manning teaches away from Park et al. and/or Noguchi et al. by teaching a field oxide formed using a trench isolation method, whereas Park et al. teaches using a LOCOS method. Therefore, the teachings of Park et al. and/or Noguchi et al. may not be properly combined with the teachings of Manning.

Even assuming that the teachings of Manning and Park et al. and/or Noguchi et al. may be combined, the resulting combination still fails to teach or suggest the device recited in claim 30. The resulting combination of teachings does not disclose a structure *having substantially straight sides ... not extending laterally from the recess over an upper surface of the substrate.*

Claim 31 depends from claim 30 and is patentable over the cited references for the same reasons as claim 30.

Claims 32-33

Similarly, claim 32 recites a microelectronic device comprising a microelectronic *substrate having a trench formed in a surface thereof*; a gate structure formed on the substrate, the gate structure including a gate oxide layer formed on the microelectronic substrate, a first gate layer formed on the gate oxide layer, an adhesion layer formed on the first gate layer, and a conductive layer formed on the adhesion layer; and a field oxide deposited in the trench, *the field oxide extending substantially perpendicularly to the surface of the substrate from the trench beyond the surface of the substrate by a height which is less than or equal to approximately one half of a height of the gate structure formed on the substrate, the field oxide having sides that are substantially straight and substantially parallel from a bottom of the trench to a top surface of the field oxide, the substantially straight sides not contacting the gate oxide layer and not extending laterally from the recess over the surface of the substrate.* (emphasis added).

Again, neither Park et al., Noguchi et al., or Manning, singly or in combination, teaches or suggests the microelectronics device recited in claim 32. Specifically, Park et al. and

Noguchi et al. do not teach or suggest a microelectronics device including a field oxide layer *having sides that are substantially straight and substantially parallel from a bottom of the trench to a top surface of the field oxide layer.* According to the teachings of Park et al. and Noguchi et al., the field oxide has the generally rounded or "bird's beak" shape typical of conventional LOCOS processes. Furthermore, according to Park et al. and Noguchi et al., there is no trench formed in the substrate that is filled with field oxide, as taught by Applicants. Similarly, Manning does not teach or suggest the microelectronics device recited in claim 32 because, according to Manning, the field oxide extends laterally over the surface of the substrate.

As described more fully above, there is no motivation to combine the teachings of Manning with the teachings of Park et al. and/or Noguchi et al. because Manning teaches away from Park et al. and/or Noguchi et al. by teaching a field oxide formed using a trench isolation method, whereas Park et al. teaches using a LOCOS method. Therefore, the teachings of Park et al. and/or Noguchi et al. may not be properly combined with the teachings of Manning.

Even assuming that the teachings of Manning and Park et al. and/or Noguchi et al. may be combined, the resulting combination still fails to teach or suggest the device recited in claim 32. The resulting combination of teachings does not disclose a structure *having substantially straight sides ... not extending laterally from the trench over an upper surface of the substrate.*

Claim 33 depends from claim 32 and is patentable over the teachings of Manning and Park et al. for the same reasons as claim 32.

Claim 34

Also, claim 34 recites a microelectronic device, comprising a microelectronic substrate having a surface with a trench formed therein; a field oxide within the trench and *having sides that are substantially straight and substantially parallel from a bottom of the trench to a top surface of the field oxide, the substantially straight sides projecting therefrom substantially perpendicularly to the surface of the substrate by a height which is small enough to prevent the formation of spacers adjacent the field oxide, the field oxide not extending laterally*

from the trench over the surface of the substrate; and a component formed on the field oxide. (emphasis added).

Again, at the risk of sounding repetitive, neither Park et al., Noguchi et al., or Manning, singly or in combination, teaches or suggests the microelectronics device recited in claim 34. Specifically, Park et al. and Noguchi et al. do not teach or suggest a microelectronics device including a field oxide layer *having sides that are substantially straight and substantially parallel from a bottom of the trench to a top surface of the field oxide layer.* According to the teachings of Park et al. and Noguchi et al., the field oxide has the generally rounded or "bird's beak" shape typical of conventional LOCOS processes. Furthermore, according to Park et al. and Noguchi et al., there is no trench formed in the substrate that is filled with field oxide, as taught by Applicants. Similarly, Manning does not teach or suggest the microelectronics device recited in claim 34 because, according to Manning, the field oxide extends laterally over the surface of the substrate.

As described more fully above, there is no motivation to combine the teachings of Manning with the teachings of Park et al. and/or Noguchi et al. because Manning teaches away from Park et al. and/or Noguchi et al. by teaching a field oxide formed using a trench isolation method, whereas Park et al. teaches using a LOCOS method. Therefore, the teachings of Park et al. and/or Noguchi et al. may not be properly combined with the teachings of Manning.

Even assuming that the teachings of Manning and Park et al. and/or Noguchi et al. may be combined, the resulting combination still fails to teach or suggest the device recited in claim 34. The resulting combination of teachings does not disclose a structure *having substantially straight sides ... not extending laterally from the trench over an upper surface of the substrate.*

For the foregoing reasons, Applicants respectfully request reconsideration and withdrawal of the rejection of claims 22 and 24-37 under 35 USC § 103(a) as being unpatentable over Park et al. (US 5,296,400) in view of Manning (U.S. 5,177,028), and the rejection of claims 22, 24-25, 28-29, and 32-37 under 35 USC § 103(a) as being unpatentable over Noguchi et al. (US 4,935,802) in view of Manning.

CONCLUSION

In light of the foregoing amendments and remarks, Applicant believes that pending claims 22 and 24-37 are in condition for allowance, and that action is respectfully requested. In accordance with 37 CFR § 1.121, attached hereto is an attached page entitled "Version with Markings to Show Changes Made" showing the specific changes made to the claims by the current amendment. If there are any remaining matters that can be handled in a telephone conference, the Examiner is invited to telephone the undersigned attorney, Dale C. Barr, at (206) 903-8745.

Respectfully submitted,
DORSEY & WHITNEY LLP

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the Claims:

Please amend claims 22, 26, 28, 30, 32, and 34 as follows:

22. (Four Times Amended) A microelectronic device, comprising:

a microelectronic substrate having an upper surface;

a gate structure including a gate oxide layer formed on the upper surface of the substrate, a first gate layer formed on the gate oxide layer, and an adhesion layer formed on the first gate layer, the gate structure having a trench at least partially disposed therein and extending into the substrate substantially perpendicularly to the upper surface of the substrate; and

a field oxide layer at least partially in the trench, the field oxide layer having sides that are substantially straight and substantially parallel from a bottom of the trench to a top surface of the field oxide layer, the substantially straight sides not contacting the gate oxide layer and extending upwardly from the trench substantially perpendicularly to the upper surface of the substrate and not extending laterally from the trench over the [an] upper surface of the substrate, the field oxide layer having a field oxide level between the level of the upper surface of the substrate and the level of an upper surface of the first gate layer.

26. (Three Times Amended) A microelectronic device, comprising:

a microelectronic substrate having a trench formed in a surface thereof, the trench extending into the substrate substantially perpendicularly to the surface of the substrate;

a field oxide in the trench, the field oxide having sides that are substantially straight and substantially parallel from a bottom of the trench to a top surface of the field oxide, the substantially straight sides projecting outwardly from the trench beyond the surface of the substrate substantially perpendicularly to the surface of the substrate and not extending laterally from the trench over the surface of the substrate; and

a component formed on the field oxide, the component extending from the field oxide by a height at least equal to approximately two times a height that the field oxide extends from the trench beyond the surface of the substrate.

28. (Three Times Amended) A microelectronic device, comprising:

a microelectronic substrate having a trench formed in a surface thereof, the trench extending into the substrate substantially perpendicularly to the surface of the substrate;

a field oxide in the trench, the field oxide having sides that are substantially straight and substantially parallel from a bottom of the trench to a top surface of the field oxide, the substantially straight sides extending from the trench beyond the surface of the substrate substantially perpendicularly to the surface of the substrate and not extending laterally from the trench over the surface of the substrate; and

a gate structure formed on the substrate, the gate structure extending from the field oxide by a height at least equal to approximately two times a height that the field oxide extends from the trench beyond the surface of the substrate, the field oxide not contacting any portion of the gate structure.

30. (Three Times Amended) A microelectronic device, comprising:

a microelectronic substrate having a recess formed in a surface thereof, the recess extending into the substrate substantially perpendicularly to the surface of the substrate; and

a field oxide deposited in the recess, the field oxide having sides that are substantially straight and substantially parallel from a bottom of the recess to a top surface of the field oxide, the substantially straight sides extending substantially perpendicularly to the surface of the substrate from the recess beyond the surface of the substrate by a height which is less than or equal to approximately one half of a height of a component formed on the field oxide, the field oxide not extending laterally from the recess over the surface of the substrate.

32. (Four Times Amended) A microelectronic device, comprising:

a microelectronic substrate having a trench formed in a surface thereof;

a gate structure formed on the substrate, the gate structure including a gate oxide layer formed on the microelectronic substrate, a first gate layer formed on the gate oxide layer,

an adhesion layer formed on the first gate layer, and a conductive layer formed on the adhesion layer; and

a field oxide deposited in the trench, the field oxide extending <u>substantially perpendicularly to the surface of the substrate</u> from the trench beyond the surface of the substrate by a height which is less than or equal to approximately one half of a height of the gate structure formed on the substrate, the field oxide having <u>sides that are substantially straight and substantially parallel from a bottom of the trench to a top surface of the field oxide, the</u> substantially straight sides not contacting the gate oxide layer and not extending laterally from the recess over the surface of the substrate.

34. (Three Times Amended) A microelectronic device, comprising:

a microelectronic substrate having a <u>surface with a</u> trench formed therein;

a field oxide within the trench and having <u>sides that are substantially straight and substantially parallel from a bottom of the trench to a top surface of the field oxide, the</u> substantially straight sides projecting therefrom <u>substantially perpendicularly to the surface of the substrate</u> by a height which is small enough to prevent the formation of spacers adjacent the field oxide, the field oxide not extending laterally from the trench over the surface of the substrate; and

a component formed on the field oxide.